BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

What is claimed is:

1. A compact counterflow heat exchanger comprising:

a plurality of longitudinally extending and parallel fluid carrying tubes arranged in thermal contact with one another, each tube having at least one bend congruent to a bend in an immediately adjacent tube; and

a first heat exchange fluid flowing through any one tube in a direction opposite to a flow direction of a second heat exchange fluid flowing through an immediately adjacent tube, thereby establishing a counter-flow heat exchange relation between the first and second heat exchange fluids.

2. The heat exchange system of claim 1, wherein the fluid carrying tubes comprise stainless steel.

3. A microchannel recuperator including a core mass, comprising multiple layers in a vertical plane of multiple fluid carrying tube arranged adjacent to each together and a substrate layer disposed in a horizontal plane, alternating tubes having a longitudinal offset bend equal to at least the width of a tube, and fluid carrying counter-flow channels comprising alternate tube layers communicating across the entire horizontal plane thereof, whereby the fluid carrying tubes of the core mass are directly adjacent to the fluid carrying counter-flow channels.

4. The microchannel recuperator of claim 3, wherein the offset bend in each tube is at least equal to ½ a dimension of any tube.

5. The microchannel recuperator of claim 4, wherein the tubes comprise stainless steel.

6 A method of making a heat exchanger comprising the steps of:

preparing a substrate layer of multiple square metal tubes arranged adjacent and physically attached to each other in a horizontal plane, each tube havinq a longitudinally extending offset bend;

configuring multiple layers in a vertical plane of multiple square metal tubes arranged adjacent to each other and the substrate layer in a horizontal plane and having interposed between each layer or multiple metal tubes Physically and communicating therewith a braze alloy thus forming a heat exchange core causing the braze alloy within the core to bond the multiple layers of multiple square metal tubes forming a core mass comprising in a vertical plane, multiple layers of multiple square metal tubes arranged adjacent and physically attached to each other and the substrate layer; forming in alternate tube layers counter-flow fluid channels communicating across the entire horizontal plane thereof;

providing the core mass with side containment shells 10 and manifolds in communication with the multiple square metal tube core mass and the counterfiow counterfiow channels; and

brazing the heat exchanger to bond parts thereof together.

7. A method of thermal transfer comprising the steps of:

providing adjacent first and second fluid carrying tubes in heat exchange contact one with another;

forming an offset bend in each tube; and flowing a first thermal transfer fluid through the first fluid carrying tubes, and flowing a second thermal transfer fluid through

the second fluid carrying tubes, respectively.

8. The method of claim 7, further comprising the step of forming the offset bend in a distance equal to at least 1/2 a dimension of the first or second fluid carrying tube.

9. The method of claim 8, further comprising the step of forming the first and second fluid carrying tubes of stainless steel.